TECHNICAL ASSESSMENT ON CURRENT TECHNIQUE OF SOLID WASTE DISPOSAL AT BERCHAM,IPOH

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Technical Assessment on the Current Technique of Solid Waste Disposal at Bercham, Ipoh

by

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Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements , and that the original work contained herein have not been taken or unspecified sources or persons

NASIBAH BINTI ISBULLAH

ABSTRACT

Solid waste disposal has become a pressing problem due to a number of factors; growth in population as well as change in lifestyle with the consumption of more modern materials and disposal products. Problems and challenges related to dumping site need to be studied and analyzed. It helps for better understanding in managing municipal solid waste. This project involves research work on landfill site condition, environmental impact on current practice, technique of solid waste disposal as well as closure and post closure of landfill. Site investigation was conducted at Bercham dumpsite, Ipoh to observe the condition and activities at the site. There are challenges encountered which are uncontrolled scavengers activities, nuisance from rodens and vermins and other technical challenges. Since the expenses for the management of municipal waste are relatively high in Malaysia and almost no value is being generated from the waste material. Therefore, in this study, methane gas production was estimated can give benefit in the future in term of generating energy. From a sample of waste at Bercham dumpsite, the chemical formula for waste at Bercham dumpsite obtained is $C_{11}H_{23}O_8N$. The result shows that 451.09 m^3 of gas generated from a tonne of waste. This volume is considered average for sanitary landfill. From the results, it shows that the site has the potential to utilize the energy generated.

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CHAPTER 1

INTRODUCTION

1.1 Background Study:

Bercham dumpsite is located in Ipoh, Perak and it has been operated since year 1986. Hitherto, the landfill receives domestic and commercial waste from residential area surrounding Ipoh. Solid waste can be a potential threat to human health and environment if not handled correctly. It is also a resource that can minimise the use of virgin materials and generate energy. According to EU-Perak SWMP report (August 2009), In Perak state, in terms of landfill capacities, the most critical area is Ipoh with its highest waste rate of 560 tonne per day (TPD) and 3 years remaining for its nearest landfill in Bercham.[Appendix A] Therefore, it is important to assess solid waste disposal at the site and the related issues. Peoples want to preserve their lifestyle while at the same time environment and public health have to be protected. The study conducted on dumping site in order to come out with appropriate solutions. This work presents assessment and researches on solid waste disposal at Bercham dumpsite and ways forward for its closure and post closure.

1.2 Problem Statement:

There has been so far, no known study being carried out on the detailed waste data in the State of Perak (EU-Perak SWMP report, August 2009) .Technical challenges on solid waste disposal lead to an immense problem to solid waste management. Improperly managing disposal of solid waste might cause a huge problem for health and environment. Breeding of disease vectors will affect the health of scavengers and residence in surrounding areas. Besides that, bad planning of closure and post closure care of site will pose bad impact to human's health and environment. Thus, a proper assessment on the solid waste disposal technique should be done to assist in minimizing or eliminating that related problems.

1.3 Objectives of Study:

The main objective of this project is to access the overall of solid waste disposal at the Bercham dumping site and to identify technical problem that occurs currently related to the landfill. The specific aims of the study are:

- To identify current challenges and problems at the Bercham dumping site.
- To presents outcomes and ways forward in minimizing the bad impacts associated with current technique of solid waste disposal.

1.4 Scope of Study:

This project involves of studying and analyzing site condition of the existing dumping site in Bercham, Ipoh. For the site operation, this study will focus on the procedure on how the solid wastes are disposed, the equipments and infrastructures involved. It also includes assessment and studies on how to improve the site and propose closure.

The study involves research on the related topics as well as field investigation where the observation and assessment is conducted on the Bercham site as well as surrounding area within one year or two semesters of studies. The study focuses on site condition, current technique of waste disposal, current problems and challenges related to site, closure and post closure care for the site in the future.

CHAPTER 2

LITERATURE REVIEW

Open dumpsite is a land disposal sites where solid wastes are disposed off in a manner that does not take into considerations the protection of the surrounding environment. Consequently, dumpsite is prone to lead to serious contamination of the soil, groundwater and air. The impact also will attract undesirable elements such as human scavengers, animals, insects and being ground for pathogenic microorganisms. All these can poses a health threat to the surrounding human population. Health and environment get jeopardized when urban infrastructure is unable to cope with increasing demands (Mark et al, 2000).

Open dumpsite is susceptible to open burning, and is exposed to the elements, disease vectors and scavengers. These unplanned heaps of uncovered wastes, often burning and surrounded by pools of stagnated polluted water, rat and fly infestations with domestic animals roaming freely and families of scavengers picking through the wastes is not only an eyesore but a great environmental hazard.

2.1 Landfill site condition

2.1.1 Site selection of sanitary landfill and dumpsite

For sanitary landfill, the objectives of site selection are to select a site with greatest protection to its environment, at low cost and public acceptance. Datta. M (1997) stated the factors which are to be considered in site selection are:

- Receptor related attributes: Population within 500m;distance to nearest drinking well; use of site by nearby residents; distance to nearest office building ;land use; critical environment
- Pathway related attributes: Distance to nearest surface water ,depth to groundwater, type of contamination; precipitation; soil permeability; bedrock permeability; depth to bedrock; susceptibility to erosion and runoff; climatic factors relating to air pollution; susceptibility to seismic activity
- Waste management related attributes: Physical state ;waste quantity; waste compatibility; use of liners; gas treatment; leachate treatment; site security; safety measures.

According to Vesilind, Worrel, Reinhart (2002), once the geographical boundary of the potential site has been determined, unsuitable locations should be identified. This process is a pass/fail test referred to as a fatal flaw analysis. Some fatal flaws are established in regulations. For example, no landfill can be sited near an active seismic fault or an airport. Other criteria are subjective and may be established by the local community, such as no landfill will be sited within one mile of a school.

Furthermore, if the local regulations and criteria it is not possible to provide a complete list of potential fatal flaws, Vesilind et al. (2002) found that following should be considered as fatal flaws:

- The site is too small
- The site is on flood plain
- The site includes wetlands
- An endangered species habitat is on the site
- The site is too close to an airport (not within 5000 ft for propeller aircraft, 10,000 ft if turbine engine aircraft)
- The site is in an area with high population density
- The site includes sacred lands
- The site includes a groundwater recharge area
- Unsuitable soil conditions (e.g., peat bogs) exist on the site

In addition to the fatal flaws there are subjective ranking criteria, which are also used. In many cases the public is asked to participate in developing the ranking criteria. For example, a site that has good access might receive five points, while a site with poor access might receive only one point.

According to Joseph K, 1992. In selecting dumping site for disposal waste, it is selected on the basis of their closeness to the collection areas rather than their technical and environmental suitability. This is one of the criteria that differentiate between sanitary landfill and dumpsite.

2.2 Environment Impact on Current Practice

Open dumps involve haphazard disposal of waste and limited measures to control operations, including those related to the environmental impacts of landfills. Nevertheless, the primitive stage development of landfill which is open dump remains the predominant waste disposal option in most of the developing countries owing to their low initial costs and lack of expertise and equipment (Johannessen and Boyer, 1999).

According to Joseph K., 2002, dumpsite pose significant risks to human health and the environment, especially as MSW become more complex in industrializing countries. In addition, the cost of remediating these sites can easily exceed their total lifetime capital and operating costs. Contaminated groundwater may never be returned to usable condition and other environmental impacts may take many decades to revolutionize.

Numerous birds that feed on the wastes are easily attracted to dump site, which can make them more serious disease vectors than flies or rodents. Liners are rarely used and little consideration is given to the water table and groundwater pollution and gas migration. The common problems occurred at site are lack of leachate collection and treatment, inadequate compaction, poor site design, and many rag pickers working at the site.

The high percentage of organics, combined with much plastic, which forms layers when compacted, contributes to the build-up of methane gases at dumps. Fires often break out and workers are made ill by the gases. Spontaneous fires also break out in dumps (Joseph K., 1992).This greatly adds to the air pollution from dump site.

The other problems associated with Open dumps (Jefferis, 1995) of solid wastes include:

- The waste is chemically and mechanically very complex
- Data on the wastes that have been put into the land dump will be scarce.

- Many of the land dumps have been sited for convenience rather than because of favorable geology and hydrogeology.
- When first established these land dumps may have been reasonably remote from the city but subsequent developments may have occurred very close to it.
- The land dump degradation process is slow.
- Land dumps continue to produce gas and leachate for decades.
- Leachate generated from the land dumps is complex and will vary with age.
- Leachate and landfill gas would have already migrated or continue to migrate from the land dump.
- Safety issues from settlement, landfill gas fires and catastrophic slippage

2.3 Technique of solid waste disposal

Gupta K. (1997) reported, the effectiveness operations carried out at the site depends upon the infrastructure facilities like:

- Waste inspection and testing facilities
- Parking mobilities for mobile
- Wheel cleaning facilities
- Correct weight record of input

According to Vesilind P A, (2002) .The movement, placement and compaction of waste and cover in a landfill require a variety of large machines, including tractors, loaders (track and wheel), and compactors. In addition a variety of support is needed, including motor graders, hydraulics excavators, water trucks and service vehicles. Specially built landfill compactors are now almost universally used. They are effective in spreading and compacting large quantities of waste.

The type and quantity of landfill vehicles are determined by the amount and type of waste handled the amount and type of soil cover, distance of moving waste and cover, weather requirements, compaction requirements, landfill configuration, budget, expected growth and supplemental tasks anticipated

2.4 Closure and post closure of dumpsite.

After the dumping site reaches its maximum capacity, the site should be closed. Closure must include long-term plans for the control of gas, leachate collection and treatment and environmental engineering. Post–closure care involves the routine inspection of the completed landfill site

A routine inspection program must be established to monitor continually the condition of the completed landfill. Meanwhile, for dumping site with no leachate collection system as well as other facilities, it is more challenging for closure planning. Long term environmental monitoring ensures that there is no release of contaminants from the landfill. (Mathur.S, 1997) .Therefore, landfill gas and leachate collection equipment has to be installed.

In order to abandon the practice of open dumping, the municipal authorities may either close the open dumps when an alternate upgraded landfill is available or alternatively it may convert its open dumps as upgraded landfills. The latter option may be feasible only if the dump is in an area where ground water pollution is not critical or if there is sufficient remaining void space to justify the cost and effort of conversion. The first step towards rehabilitating open dumps should be to analyze the condition of the site and its geographical setting. The investigations need to be undertaken before the choice can be made on whether to close or convert the site, since the findings can guide the decision. (Joseph K, 1992)

As a minimum the following steps may be initiated to slowly move from open dumps towards sustainable landfills. (Joseph K, 1992):

- Fires should be eliminated on the dump site
- Waste tipping should be restricted into small areas and a disposal plan must be followed

- Wastes should be deposited in thin layers of about 50 cm and compacted appropriately
- The surface of the newly deposited waste should be covered at the end of each day with approximately 15 cm of soil or similar material.
- Install landfill gas collection and rainwater diversion systems
- Keep the site access roads in good condition to allow vehicles to deposit wastes at designated places as quickly as possible
- The disposal site should be protected from scavengers/ public by boundary walls and access gates
- Records of waste deliveries and tipping should be maintained
- Carry out Environmental (Simple visual inspection to complex chemical analysis) monitoring should be done
- Provide for essential staff to manage the operation such as a landfill manager, office clerk, security, traffic controller, landfill equipment drivers and mechanic

2.4.1 Control of dumpsite gas

Landfill gas is generated as a product of waste biodegration. Biological degradation of the waste may occur in the presence of oxygen (aerobic bacteria), in an environment devoid of oxygen (anaerobic bacteria), or with very little oxygen (facultative anaerobic bacteria). In the presence of moisture and appropriate nutrients, the anaerobic process and gas generation could extend over several years period after completion of the landfill. (Datta. M, 1997)

2.4.1.1 Gas Quantity with Time

Estimating gas production at landfill can be beneficial in term of generating power and conserve the environment. It is observed that under normal conditions, the rate of gas production, reaches a peak within the first few years and then slowly tapers off (Figure 2.1), continuing in many cases for periods up to 25 years or more. (Datta M, 1997)

In many landfills, the moisture that is present is not uniformly distributed. When the moisture content of landfill is limited, the gas production is more flattened out and is extended over a greater period of time (Figure 2.2). The production of landfill gas over extended periods of time is of great significance with respect to the management strategy to be adopted for post closure maintenance.

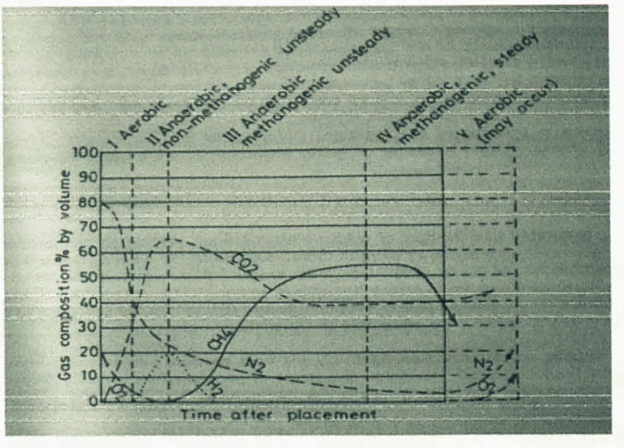

Figure 2.1: Phases in Landfill Gas

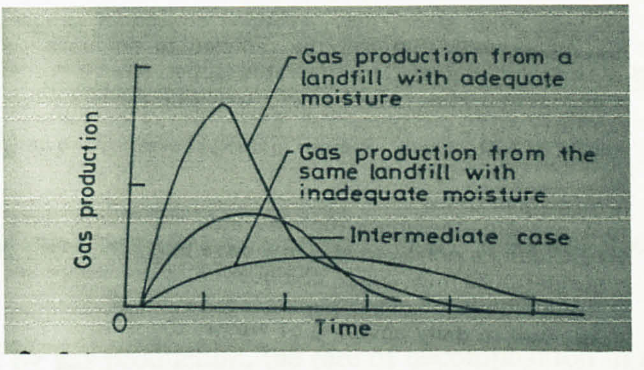

Figure 2.2: Schematic Variation of Landfill Gas generation With Time

Landfill gas generation rates vary over a wide range .Typical generation rates reported in literature vary form 1.0 to 8.0 liters/kg/year.

2.4.1.2 Gas Extraction System (Active system)

Gas control involves a system collecting and removing landfill gas within the landfill and in particular from the perimeter of landfill. Methane gas extraction from landfills is carried out so that the landfill gas can be burnt in a flare or be used to power a gas engine power generator. In many countries a number of these systems are being installed or have recently been installed. Datta. M (1997) reported that in active control systems, energy in the form of an induced suction is used to extract gas from within the waste.

2.4.1.3 Gas Estimation

Landfill gas is usually converted to electricity when available in significant quantities. The overall anaerobic conversion of organic industrial wastes can be presented with the following equation, if it is assumed that the organic wastes are stabilized completely, the corresponding expression is:

$$CaHbOcNd + (4a-b-2c+3d / 4)\ H2O \rightarrow$$
$$(4a+b-2c-3d / 8)\ CH_4 + (4a-b+2c+3d/8)\ CO_2 + dNH_3$$

(Equation 2.1)

a, b, c and d is the coefficient base on solid waste chemical composition

As measured by gas production, the rate of decomposition in unmanaged landfills reaches a peak within the first 2 years and then slowly tapers off. In many cases, it continues for period up to 25 years or more. (Peavy H.S, Rowe D.r, Tchobanoglous G) The total volume of gas can be estimated by using Equation 1 with the assumption of complete conversion to carbon dioxide and methane

CHAPTER 3

METHODOLOGY

Two major steps involved in completing this project. The steps consist of research work as well as field investigation of solid waste disposal at Bercham Landfill Site. For this study, the following approach will be adopted

3.1 Methodology

3.1.1 Research work:

1. Identify problem and objectives
2. Review relevant literature , publications and studies in order to get in-depth information on solid waste disposal topic
3. Collect comprehensive information from local authority (Dewan Bandaraya Ipoh, DBI) through interview and discussion sessions
4. Assessment of informations and data collected

3.1.2 Field Investigations:

1. Observe overall flow process of disposal technique of solid waste
2. Assessment of infrastructures in landfill site (vehicles, equipments, etc.)
3. Observe specific technique of unloading, spreading and compacting of solid waste at dumping area.
4. Identify problems and current situation at Bercham Landfill Site.

3.1.3 Area of Study

The details of methodology adopted in this research are as specified for each scope of study:

3.1.3.1 Site Condition and Current Problem at site

This study involved research on the available literature on the objective of site selection for sanitary landfill. The literature is compared to the condition of the Bercham dumping site.

3.1.3.2 Closure and Post Closure of site

Estimating methane gas production for overview of the energy generated after its closure. Besides that, gas and leachate monitoring and collection system is studied.

3.2 Hardware and Tools

Personal Protective Equipment, PPE (i.e; safety boots, mask and etc,) and camera for assessing dumpsites.

CHAPTER 4

RESULTS & DISCUSSIONS

4.1 Overall Flow Process of Solid Waste Disposal and Challenges related to site.

During site investigation, observations were made on the overall flow of disposal the solid waste. Process of disposing solid waste at the Bercham site, basically as summarized in the figure 1;

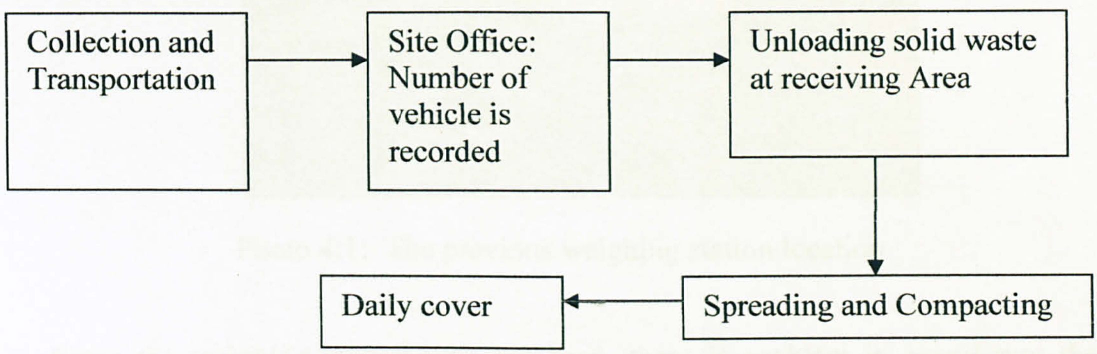

Figure 4.1: Solid Waste Disposal Flow at Bercham Dumpsite

In the daily operation at Bercham site, the incoming refuse was recorded manually in a logbook by a worker at the site office. Then the truck will go to the waste receiving area. There, refuse is unloaded directly at the top of the working face and into daily disposal area. Each disposal area contains the refuse delivered to the site on that day. The incoming refuse is unloaded within active dumping area. Refuse is spread and compacted using trash compaction equipment. Daily cover using sand was done at night to avoid from smelly, fire and harboring rodent and vermin.

4.1.1 Record of incoming lorry

From the investigation, currently there is no weighing station for the incoming trucks to the landfill since the previous one had damaged in year 2005.

The current practice at Bercham site is to record incoming lorry/trucks manually by worker at site office in a log book. For private lorry/trucks, they will be charged with certain amount per lorry.

Photo 4.1: The previous weighing station location

Since the weighing station was damaged, there is problem in calculating the capacity of incoming waste everyday. Therefore, some estimation needed to calculate the capacity of waste. The estimation can be calculated as follow:

Capacity of waste per day

= Number of incoming lorry x estimated capacity per lorry

However, the estimation might no be accurate since not every lorry comes with the full or maximum capacity. In this case, previous recorded data might be a useful reference to estimate lorry which is not fully loaded.

4.1.2 Disposal of waste

After the lorry has been recorded, it will head to the receiving area located about 300 meters from site office. The lorry unloaded the waste at receiving area. The compactor will spread and compact the refuse uniformly. Compacted waste is covered with sand everyday. Normally, the cover work done at night. On the next day, the coming waste will be deposited on that layer. The process will continue until the current used cell achieves maximum capacity.

Photo 4.2: Truck is unloading the waste

Photo 4.3: Spreading and compacting of waste

4.1.3 Infrastructures at the Bercham Landfill Site

During site investigation, observation was made on the infrastructures at the site. Basically, the site was equipped with:

- Site Office
- Lorry Cleaning Station
- Contractor Site Office
- Security Guard Office
- Toilet and mosque

Photo 4.4: Site office

Photo 4.5: Lorry cleaning station

From the observation and survey the workers at the site, the infrastructure is satisfactory but there is no fence to restrict assess of scavengers into the site and animals like cows and buffaloes roaming freely in the site. The disposal site should be protected from scavenger or public by boundary walls and access gates

4.1.4 Other challenges and problems at Bercham site

One of the challenges that author want to highlight is the health, safety and environment issues. One of problems the Bercham site is currently facing is the nuisance from odors, flies and insects as well as other animals such as cow at the area where the refuse were placed.

Photo 4.6: Nuisance from surrounding animal

Another serious problem that has to be noted here in Bercham dumpsite, the activities of scavengers are getting increase. This could be a serious hazard of exposure of scavengers to health risks.

Photo 4.7: Scavenger's activities at Bercham site

During site investigation, it is estimated around 20-30 scavengers doing scavenging activities at site for a certain time. From the survey of the site worker the number of scavengers is higher in the morning. The unrestricted access of scavengers who search for recyclable materials in the dumpsite areas exposes them to dangers of exposure to hazardous substances in the waste. The authority has to take immediate action regarding this issue.

Scavenging is disruptive to good landfill operation. It presents safety hazards to both scavengers themselves and landfill employees. It reduces productivity by delaying waste compaction and soil cover.

4.2 Closure and Post Closure

The dumping site at Bercham Ipoh is currently not equipped with gas and leachate control system. The site is estimated to reach its maximum capacity within 2 years onward. Therefore, from researches and studies on the closure of the landfill, it can be said that, immediate measure must be taken in a number of few critical areas:

- The migration of gas from dumping site is a concern since gas can move to the surrounding depending on their density. Venting and flaring of combustible methane gas generated by the decomposition of biodegradable materials is one of the solutions. Besides that, another initiative is to estimate the production of methane gas that can eventually give us overview of the energy generated.
- Control and treatment of leachate is another concern since the old dumping site will continuously produce leachate.

4.2.1 Estimation of Methane Gas

A sample of waste was taken randomly. Following are steps of estimating methane gas production of landfill

4.3.1.1 Estimating chemical composition of a solid waste sample

An approximate chemical formula for the organic portion of a solid waste sample with the composition given in the table 4.1.The resulting chemical composition is used to estimate the methane gas production.

Table 4.1: Solid waste sample composition

Component	Wet Mass,Kg	Dry Mass,Kg	Composition,Kg				
			C	H	O	N	S
Food Waste	0.85	0.479	0.23	0.031	0.18	0.012	0.002
Paper	0.655	0.545	0.237	0.031	0.24	0.002	0.001
Plastic	1.405	1.375	0.825	0.099	0.314		
Rubber	0.11	0.11	0.086	0.011	0.034	0.002	
Total	3.02	2.509	1.378	0.172	0.768	0.016	0.003

Note: Composition of sample is estimate with reference to typical data on ultimate analysis of the combustible components in municipal solid wastes (Appendix)

Table 4.2: Summary of the solid waste sample composition

Component	Mass,kg
Moisture	0.511
Carbon	1.378
Hydrogen	0.172
Oxygen	0.768
Nitrogen	0.016
Sulfur	0.003

Moisture content reported in step above is converted to hydrogen and oxygen:

Hydrogen = 2/18 x 0.511 = 0.057 kg

Oxygen =16/18 x 0.511 = 0.45 kg

Component	Mass,kg	Percent by mass, %
Carbon	1.378	48.5
Hydrogen	0.229	8.05
Oxygen	1.218	42.83
Nitrogen	0.016	0.56
Sulfur	0.003	0.11
Total	2.844	100

Molar composition of the elements is computed:

Table 4.3: Molar composition of solid waste sample element

Component	Mass,kg	Kg/mol	Moles
Carbon	1.378	12.01	0.11
Hydrogen	0.229	1.01	0.23
Oxygen	1.218	16.00	0.08
Nitrogen	0.016	14.01	0.01
Sulfur	0.003	32.06	0.0001

Approximate chemical formula without sulfur is determine

Table 4.4: Approximate chemical formula without sulfur

Element	Nitrogen=1
Carbon	11
Hydrogen	23
Oxygen	8
Nitrogen	1

Thus, chemical formula without sulfur = $\mathbf{C_{11}H_{23}O_{8}N}$

4.3.1.2 Estimating Methane Production:

Assumption made is that the organic wastes are stabilized completely, thus the corresponding expression is;

$$C_aH_bO_cN_d + (4a-b-2c+3d)/4\ H_2O \rightarrow (4a+b-2c-3d)/8\ CH_4 + (4a-b+2c+3d)/8\ CO_2 + dNH_3$$

(Equation…)

With the coefficients;

a =1 b =23 c = 8 d = 1

Using these coefficients the resulting equation is:

$$C_{11}H_{23}O_8N + 2H_2O \rightarrow 6CH_4 + 5\ O_2 + NH_3$$

(297) (96)

The mass of methane produced per tonne of waste is determined

Methane = 96/ 297 x 1000 kg/tonne =323.3 kg/tonne

Using a density value for methane of 0.7167 kg/m^3, the volume of methane is determined

Volume of methane gas = 323.3 kg/tonne / 0.7167 kg/m^3

<u>= 451.09 m^3/ tonne of waste.</u>

In practice, a portion of the waste would be used for the synthesis of cell tissue. The actual volume of gas would be about 0.85 times the value determined above.

4.2.2 Gas Extraction

From the observation at the site, studies and researches, gas produced from the Bercham dumping site is possible to be extracted It is also noted from the methane gas estimation; there is a significant amount of methane gas produced from solid waste of Ipoh. Methane at the dumping site must be burned off and eliminated to prevent the possibility of fire. In history, the fire had occurred in 1996 on this site. In the meantime, it is possible to convert the methane gas produced at the landfill into a source of revenue.

Since there is no gas collection system at the site currently, therefore one of way to extract the gas is through active system which is in the form of induced suction to extract gas from within the waste.

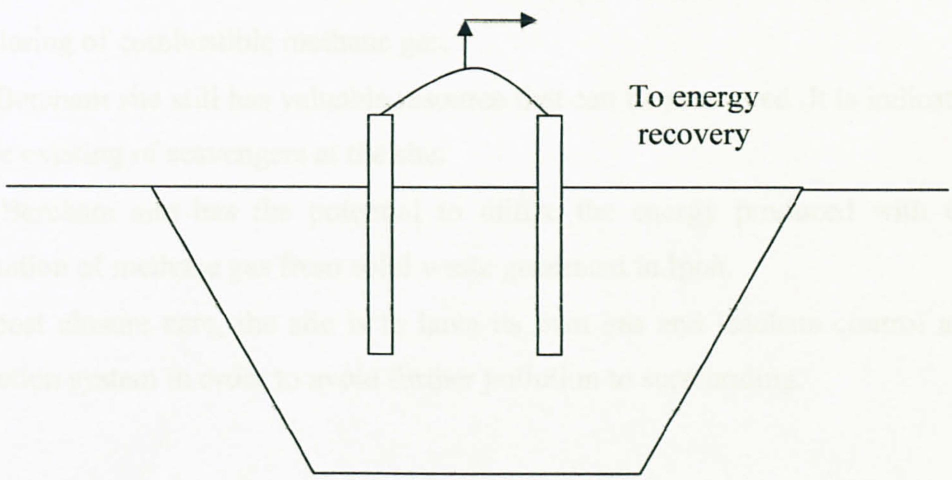

Figure 4.2: Gas recovery through wells

The main components of the system are; gas wells or drains in the waste, pipework leading from the wells to the pump, condensate trap s to remove condensed liquid from the systems , pumps which induce suction and remove the gas and transmit the gas to utilization plant.

CHAPTER 5

CONCLUSIONS & RECOMMENDATIONS

Conclusions:

This study involves more on researches work and some of site investigation that finally comes out with a few finding that is expected to add information of the Bercham site in better understanding of solid waste management. It can be concluded that;

- Immediate measures must be taken on a few critical areas which are; regulating the scavengers, control and treatment of waste liquid leachate as well as venting and flaring of combustible methane gas.
- The Bercham site still has valuable resource that can be recovered .It is indicated by the existing of scavengers at the site.
- The Bercham site has the potential to utilize the energy produced with the estimation of methane gas from solid waste generated in Ipoh.
- For post closure care, the site is to have its own gas and leachate control and collection system in order to avoid further pollution to surrounding.

Recommendations:

Several recommendations have been identified to aid improving current research work for further investigations. The followings are the author suggestions to improve this project in such it could produce better findings in the future.

- It is recommended to extend the period of study for further studies on methane gas production .The installation of gas extraction system also need further study on the cost of installation as well as more on technical side of it.
- Since the dumpsite is expected to close in the remaining 2-3 years, the study and research should focus on rehabilitation and upgrading of the dumpsites that requires immediate action in order to stop any further contamination of the surrounding environment and community health.

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EU-Solid Waste Management Plan Report (August 2009)

APPENDICES

A. Typical data on ultimate analysis of the combustible components in municipal solid wastes

B. Waste Management data in the city of Ipoh

C. Figure 7: Location of landfill and dumpsites in Malaysia and the state of Perak
Table 9: Remaining Capacities of Dumpsites in Perak
Table 10: Waste Generation Per Capita of Localities in the State of Perak

D. Schedule A: Overview of Waste Stream Flow in the State of Perak

E. Map of Bercham landfill

F. FYP 2 Gantt Chart

Appendix A:

Typical data on ultimate analysis of the combustible components in municipal solid wastes:

Table 10-8 Typical data on ultimate analysis of the combustible components in municipal solid wastes

	Percent by mass (dry basis)					
Component	Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur	Ash
Food wastes	48.0	6.4	37.6	2.6	0.4	5.0
Paper	43.5	6.0	44.0	0.3	0.2	6.0
Cardboard	44.0	5.9	44.6	0.3	0.2	5.0
Plastic	60.0	7.2	22.8	—	—	10.0
Textiles	55.0	6.6	31.2	4.6	0.15	2.5
Rubber	78.0	10.0	—	2.0	—	10.0
Leather	60.0	8.0	11.6	10.0	0.4	10.0
Garden trimmings	47.8	6.0	38.0	3.4	0.3	4.5
Wood	49.5	6.0	42.7	0.2	0.1	1.5
Misc. organics	48.5	6.5	37.5	2.2	0.3	5.0
Dirt, ashes, brick, etc.	26.3	3.0	2.0	0.5	0.2	68.0

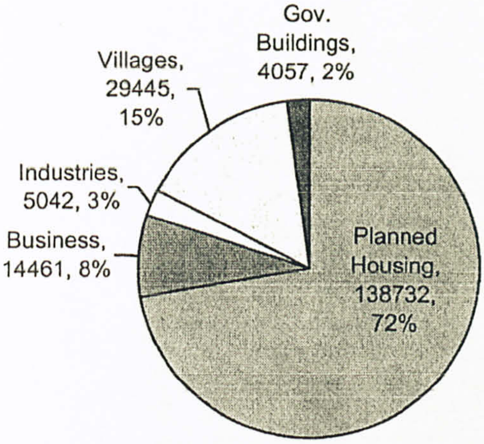
Source: From Tchobanoglous et al. [10-5]

Appendix B:

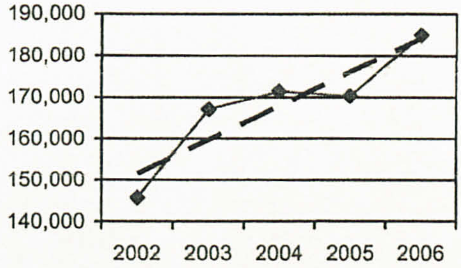
Waste Management data in the city of Ipoh

Fact Sheet 1 : Waste Management Data in the City of Ipoh

Population : 612,600   Area : 643 sq.km

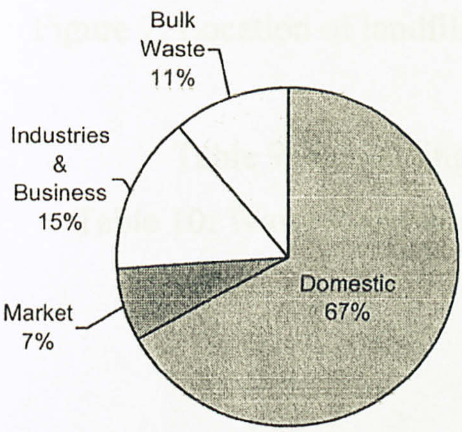


Holding Properties of Ipoh City Council



Annual Disposal of Solid Waste

- Daily generation: 550-600 tonnes/day
- Waste per capita daily : 0.85 kg
- Rate of increase : 5.4% per annum



Generation of Solid Waste by Source (Year 2006)

Vehicle Type	Units
Compactor Lorries	91
Open Lorries	14
Roll-on-roll-off Lorries	2

Collection Fleet Resources

Waste Type	Frequency
Domestic Waste	3X weekly
Industrial Waste	3X weekly
Market & Hawkers Waste	Daily
Bulky Waste	1X Monthly

Collection Schedule

Problem of Illegal Rubbish Dumpsites
- Major persistent problem
- Repeated dumping at same sites
- Lack of cooperation from public

Current Waste Treatment Method
- Final disposal at dumpsites
- Daily covering of dumped waste with soil
- No leachate treatment or odour prevention measures

Appendix C:

Figure 7: Location of landfill and dumpsites in Malaysia and the state of Perak

Table 9: Remaining Capacities of Dumpsites in Perak

Table 10: Waste Generation Per Capita of Localities in the State of Perak

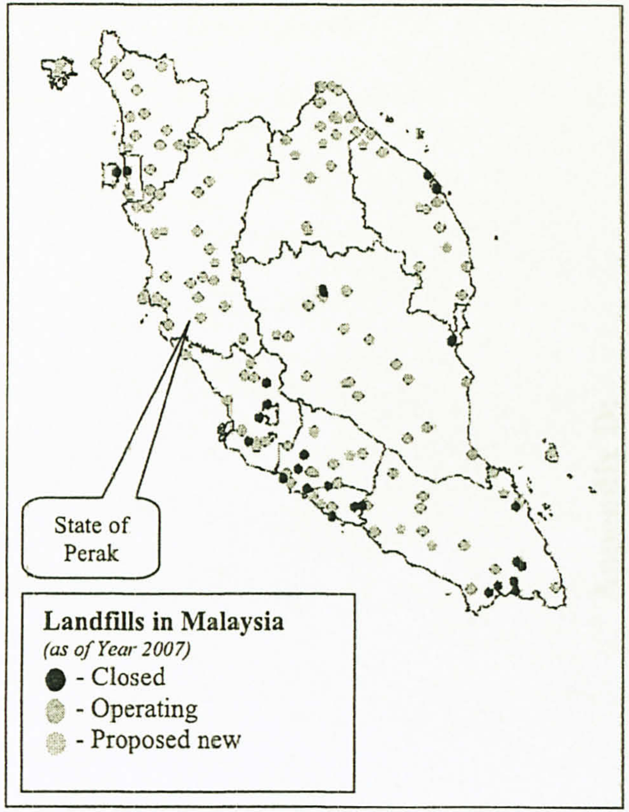


Figure 7 : Location of Landfills & Dumpsites in Malaysia and the State of Perak
Source : National Solid Waste Management Department /DANIDA

DUMPSITE	Remaining Capacity (tonnes)
Teluk Cempedak	*N.A.*
Beruas	*N.A.*
Sg. Wangi	*N.A.*
Ayer Tawar	*N.A.*
Parit Buntar	*N.A.*
Bagan Serai	43,800
Bagan Datoh	*N.A.*
Batu $7^1/_2$	102,200
Parit	2,920
Kpg Gajah	2,920
Jebong	182,500
Ayer Kala	7,300
Tmn Mendeka	8,030
Penderas	18,250
Bercham	408,800
Lahat	*N.A.*
Batu Gajah	32,850
Jalan Gerik	7,300
Jalan Kuala Kangsar	129,940
Pekan Pasir	36,500
Jalan Air Ganda Gerik	13,140
Sg Siput Selatan	51,100
KNOWN TOTAL	**1,047,550**

The remaining capacities of dumpsites in Perak are estimated based on the lifespan and rate of incoming waste into the sites
Table 9 : Remaining Capacities of Dumpsites in Perak

Council Area	Population	Waste generation (kg/capita/day)
Manjung	199,450	**1.409**
Kerian	116,942	**1.539**
Teluk Intan	131,026	**1.297**
Perak Tengah	47,474	0.169
Taiping	235,722	1.061
Lenggong	17,650	0.567
Selama	33,402	0.329
Tanjung Malim	38,409	0.651
Ipoh	629,892	0.889
Kinta Barat	81,740	0.551
Pengkalan Hulu	17,357	0.576
Kuala Kangsar	113,857	**1.563**
Tapah	79,383	0.630
Gerik	31,856	0.502
Kinta Selatan	86,592	0.808

Table 10 : Waste Generation Per Capita of Localities in the State of Perak

Appendix D:

Schedule A: Overview of Waste Stream Flow in the State of Perak

Schedule A : Overview of Waste Stream Flow in the State of Perak

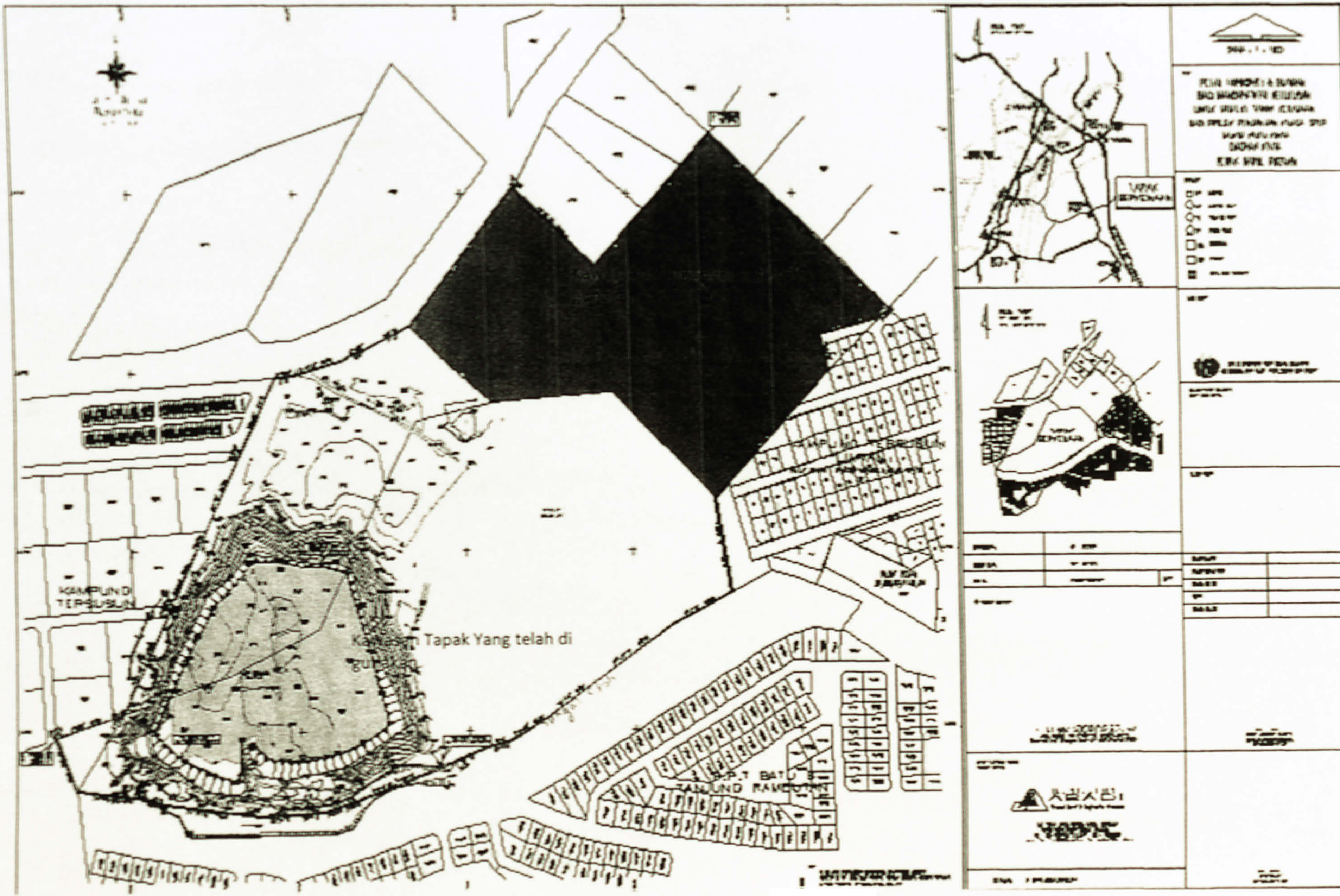
Dumpsites		State of Perak : City Councils, Town Councils & District Councils														
Location	*Life Span Remains*	Manjung.	Kerian	Teluk Intan	Perak Tengah.	Taiping	Lenggong	Selama.	Tanjung Malim	Ipoh	Kinta Barat	Pengkalan Hulu	Kuala Kangsar	Tapah	Gerik	Kinta Selatan
Teluk Cempedak	*Exceeded*	14 TPD														
Beruas	*N.A.*	7 TPD														
Sg. Wangi	*N.A.*	160 TPD														
Ayer Tawar	*N.A.*	100 TPD														
Parit Buntar	*Exceeded*		120 TPD													
Bagan Serai	*2 yrs*		60 TPD													
Bagan Datoh	*Exceeded*			30 TPD												
Batu $7^1/_2$	*8 yrs*			140 TPD												
Parit	*1 yrs*				4 TPD											
Kpg Gajah	*3 yrs*				4 TPD											
Jebong	*2 yrs*					250 TPD										
Ayer Kala	*2 yrs*						10 TPD									
Tmn Mendeka	*2 yrs*							11 TPD								
Penderas	*2 yrs*								25 TPD							
Bercham	*3 yrs*									560 TPD						
Lahat	*N.A.*									N.A.	N.A.					N.A.
Batu Gajah	*5 yrs*										45 TPD					
Jalan Gerik	*6 yrs*											10 TPD				
Jalan Kuala Kangsar	*8 yrs*												178 TPD			
Pekan Pasir	*8 yrs*													50 TPD		
Jalan Air Ganda Gerik	*15 yrs*														18 TPD	
Sg Siput Selatan	*18 yrs*															70 TPD

Source : State Government of Perak, Presentation Notes by the Ipoh City Mayor 2008

Appendix E:

Map of Bercham landfill

PETA KAWASAN OPERASI TAPAK



Appendix F:

FYP 2 Gantt Chart

GANTT CHART
FINAL YEAR PROJECT II
Title: Current Technique of Solid Waste Disposal at Bercham Landfill Site
NAME: NASIBAH BT ISBULLAH
ID NO: 7915 HP NO: 013-9033109

ACTIVITIES	AUGUST				SEPTEMBER				OCTOBER				NOVEMBER			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
SITE CONDITION																
Analyse & compare sanitary landfill and dumpsite criteria																
TECHNIQUES OF SOLID WASTE DISPOSAL																
Study on Process flow																
Study on Equipments																
PROBLEMS RELATED TO SITE																
Survey on:																
Health, Safety and Environment aspect																
CLOSURE AND POST CLOSURE ANALYSIS																
Estimation of methane gas																
Improvement																
POSTER EXHIBITION																
SUBMISSION OF FINAL REPORT(softbound)																
ORAL PRESENTATION																